When you are using a new developing solution, time-gamma or time-contrast index charts (as appropriate) must be developed for the variety of films to be processed in it. Given time, temperature, and agitation for each particular film in the developer, you will be able to see the results on these time charts.

After the developer solution has been proven, you should process a sensitometric strip with each processing run. Each sensitometric strip should be read with a densitometer and plotted on the appropriate process-monitoring chart. As a minimum, you should process and plot a control strip after start-up and before shut down or at the beginning and end of each work shift. Once the densities are recorded and plotted, an accurate graphic representation of the activity of the process is provided.

QUALITY ASSURANCE CONTROL CHARTS

In photographic processing, control charts are used to monitor the status of specific solutions and the physical process. A list of numbers can be studied carefully to see whether they are out of line; however, when the numbers are plotted on a chart, you can see instantly whether there is data out of order.

Photographic quality assurance control charts can be prepared for gamma or contrast index, minimum and maximum density (D-min and D-max), average density ($\bar{D}$), gross fog, temperature, pH, specific gravity, or any other variable that may be required by your quality assurance program. To be useful in your quality assurance program, you must collect and record data relative to these and other specific factors. From the recorded data, you can calculate the mean or average, and determine the upper and lower limits.

If, for example, the control gamma in an aerial film processor is 1.50 and the desired average density is 1.65, you must have a method for indicating when the gamma or $\bar{D}$ varies to the point where the end result is no longer desirable. When the gamma tolerance limit is ±0.05 *and* the $\bar{D}$ tolerance limit is ±0.07, the control chart appears as shown in figure 2-12.

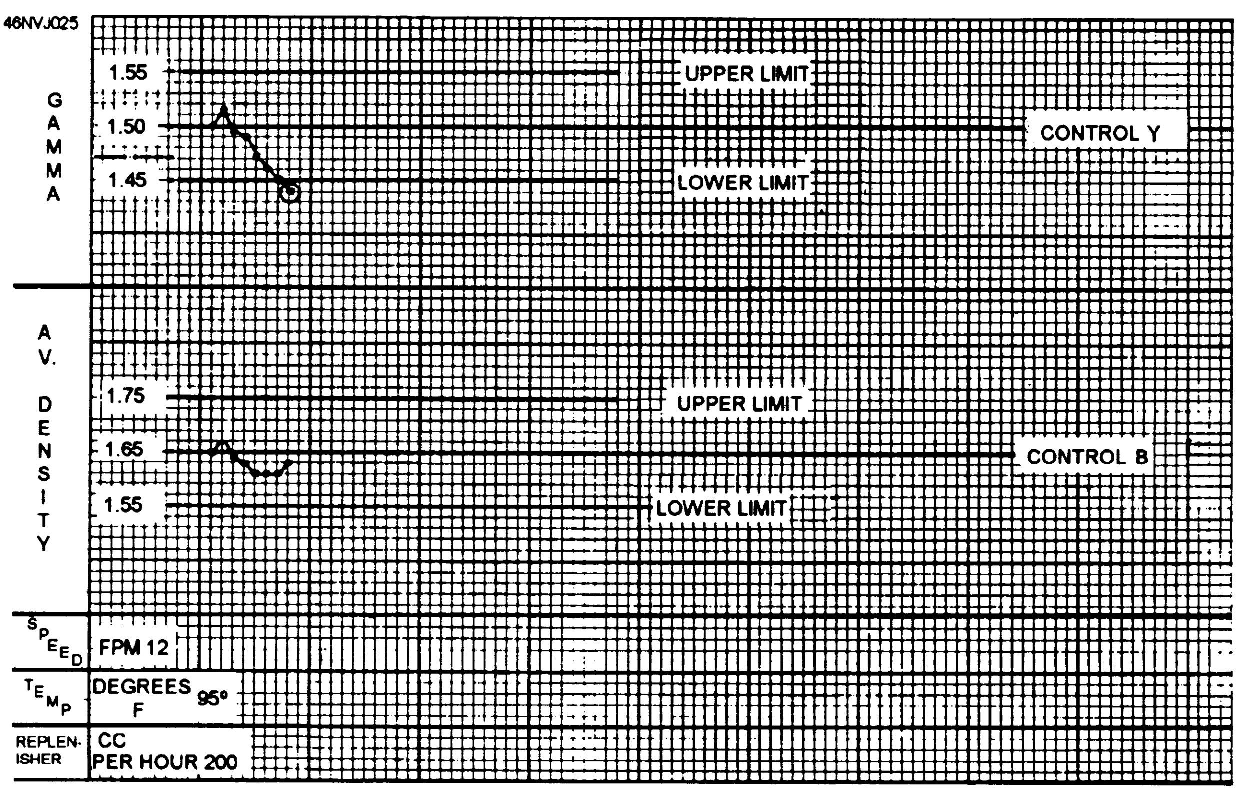


Figure 2-12.—Control chart.

From each processing run, you should plot the gamma and $\bar{D}$ on the chart. You should write other data, such as processing time (or machine speed), temperature, rate of replenishment, and amount of film processed, on the control chart. After connecting the dots, you will know what the processor is doing and the direction in which the process is going.

Remember that the existing tolerance or control limits, once set, should not be left there indefinitely. You should continually strive to improve the degree of control and, to do so, reestablish closer control limits periodically.

The amount of information you can plot on control charts depends on several factors that may include, but are not limited to, the following:

- The product quality required
- The equipment available
- Personnel available and trained for QA duties

You are not expected to monitor all the variables that are listed. Also you are not limited on what you can monitor. These decisions depend on the capabilities of each imaging facility, and they change periodically. Figure 2-13 shows the way a control chart might look. It is an example only and should not be used to establish control parameters in your imaging facility.

Before control charts are established, you must have a standard or starting point for each of the variables you intend to measure. These standards are derived by sensitometric or chemical tests over a given period of time or, in the case of color processing, are provided by the manufacturer. Generally speaking, when these tests are conducted within an imaging facility, they are to be performed by a PH with a background in photographic quality control (NEC 8126) or by a PH with extensive on-the-job training in QA. These specialists analyze the data collected over the test period, apply statistical formulas, and arrive at workable standards or means and upper- and lower-control limits. Therefore, in the rest of the discussion, assume that these standards have already been established. A word of caution, however, the chart, plot, and curve illustrations that follow are presented as *examples only.* They should not be used as a basis for the QA program in any lab.

PLOTTING GAMMA OR CI ON A PROCESS-MONITORING CHART

As explained previously, gamma and CI can be computed from the information plotted on a characteristic curve. Successive values are then plotted on control charts.

When gamma plots on a control chart beyond the control limits, several causes may be indicated, some of which include the following:

- The developer is being over- or under-replenished.
- The film was over- or underdeveloped.
- The processing temperature was too high or too low.

PLOTTING HIGH DENSITY ON A PROCESS CONTROL CHART

A density step from a processed control strip is plotted as the high density (HD) on a control chart. The specific step number is determined in tests as discussed previously. Once this step has been determined, it should be used for each reading or plot until a new standard or mean is determined. For the purpose of our example, we are plotting or measuring step 16 as high density.

The following factors can cause the high density to be out of control:

- Variations in the processing temperature
- Variations in the processing time or machine speed
- Over- or underreplenishment

PLOTTING LOW DENSITY ON A PROCESS CONTROL CHART

As with high density, low-density (LD) readings should also be taken from a predetermined density step of a control strip.

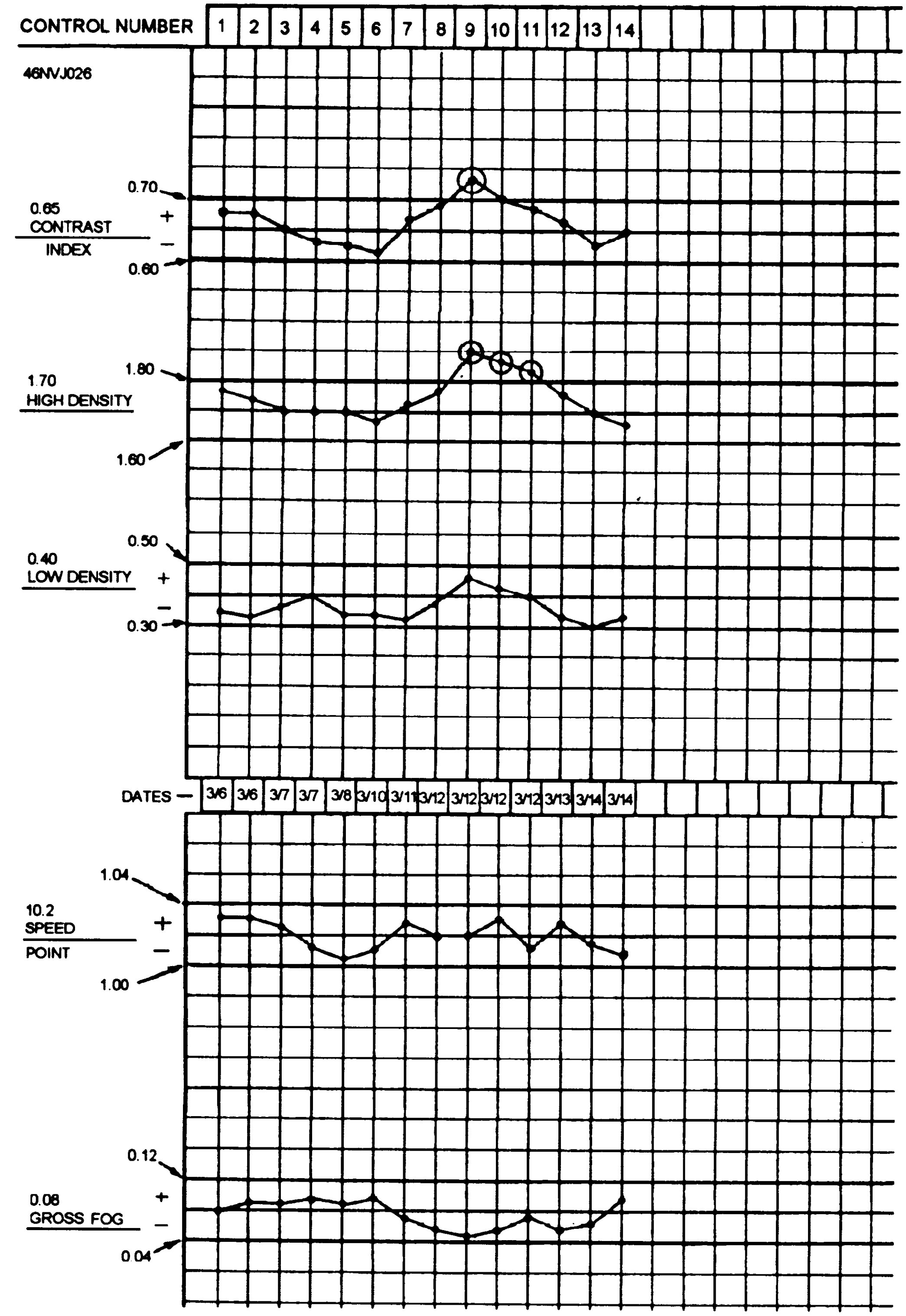


Figure 2-13.—Quality control chart.

The same factors that affect high density affect low density.

PLOTTING SPEED POINT ON A PROCESS CONTROL CHART

The speed point (SP) is a measure of the effective film speed or exposure index of a film. The speed point is determined by sensitometric tests. The speed point is established using a step on a sensi-strip with a density of 0.10 above gross fog for ground pictorial film. The speed point of aerial film is established by using the step on a sensi-strip that has a density of 0.30 above gross fog.

Once the speed-point step is determined, that step is read in successive sensi-strips and plotted on the control chart. Neither effective film speed nor the ISO for ground pictorial film should be confused with effective aerial film speed because they are not equivalent.

PLOTTING GROSS FOG ON A PROCESS CONTROL CHART

Gross fog (B+F) is read from a "clear" area of a control strip; that is, an area that does not receive exposure. All films have a gross fog density, resulting from several factors that may include the following:

- The density of the film base
- Chemical fog
- Age fog
- The development of unexposed silver halides
- Inadequate fixation (film not cleared)

As stated earlier, the amount of information you use to monitor or control your process depends on several factors. However, when you choose to monitor more than one processing variable, you should construct the appropriate control chart or use a piece of graph paper that can be posted near the process. Figure 2-14 shows a typical family of control charts for a process. A family of control charts, such as this, will provide you with a wealth of information about the process. Also, all the information is in one place.

LIMIT LINES

The upper- and lower-limit lines on a control chart are based on the assumption that the plotted points are representative of a normal "population" or set of circumstances of the process. The limit lines, therefore, should include between them, all points representing an unchanged or normal process. Limit lines can never be placed in such a manner that all data are included between them; there will always be deviations. Samples from a black-and-white process, for example, show a gamma average of 0.70. On a subsequent test, a sensitometric strip was found to have a gamma of 0.80. Obviously this process appears to have changed or is changing. Should the process be altered? The answer must consider the factor of probability.

Two risks are involved in judging whether normal limits are exceeded. One risk occurs when a certain sampling appears outside one of the limit lines, indicating that the process is out of control, but the process is actually behaving normally and has not changed. This situation is known as the *alpha risk.* The reverse is also possible; it appears that the process is normal when actually it has changed or is changing. This is called a *beta risk.* These occurrences cannot be eliminated, but they can be reduced to the point where the probability of their happening is small. One risk is usually more costly than the other, and the limits are set accordingly. The limits are set far from the mean when the alpha risk must be avoided. They are set close to the mean when the beta risk must be avoided.

It is standard practice in black-and-white processing to place the limit lines at three times the standard deviation above and below the mean, or $\pm 3s$. The alpha risk is approximately 3 in 1,000 for limits of $\pm 3s$. Before proceeding, it is necessary to define the following two terms:

- Population—all possible results (happenings) in a certain process
- Variability—the amount of departure of measurements (parts of the population) from the mean (average)

Variability may be expressed in the following ways:

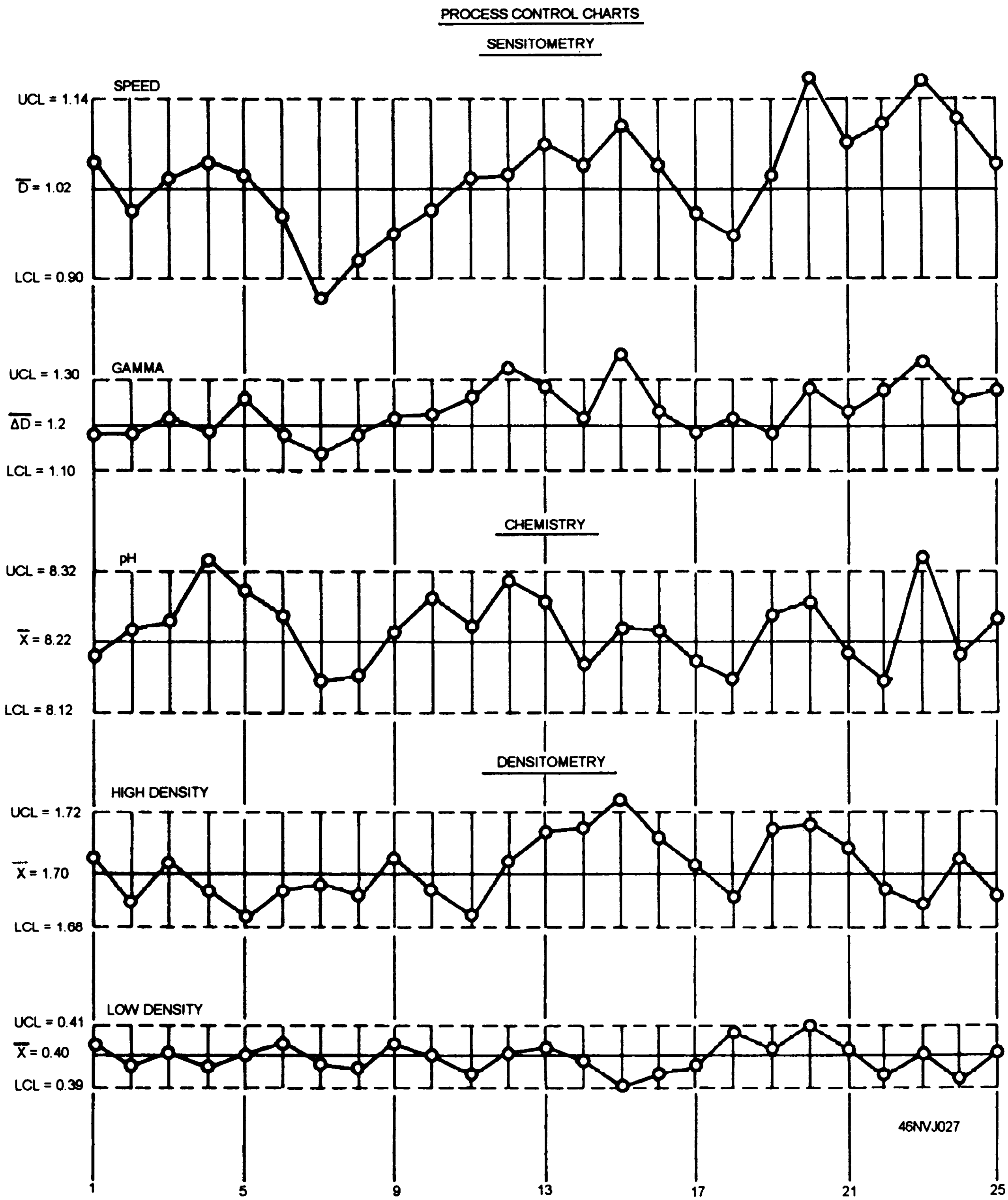


Figure 2-14.—Control chart examples.

- *Range*—the difference between the largest and smallest numbers of the set

- *Deviation*—the amount each element of the population is away from the mean

- *Standard error*—the average percent of deviation from the mean

CONTROL CHART INTERPRETATION

Control charts for film processing should be maintained as long as the process is in operation. For control charts to be of value, you should remember the following guidelines:

- There must be a continuous analysis of a statistical nature of photo-processing control charts.

- It is pointless to maintain control charts, then fail to act when the chart indicates a problem in the process.

- Control charts let you visually determine a definite processing problem occurring among random process variations.

- There is always a certain amount of natural variability in a process.

- There can be overcontrol, as well as undercontrol, in precision quality assurance processing. Overcontrol of a process can be needlessly expensive.

These guidelines cannot be overemphasized and should become an integral part of your processing philosophy. Each process control chart you maintain can illustrate five possible conditions of that process. These conditions depend upon variations within that process. These five conditions are shown in figure 2-15.

A *normal pattern* exists in all processes that are operating correctly. This pattern reflects the variability that cannot be controlled or eliminated completely. When an *out-of-control* condition exists, immediate action should be taken to correct the problem. When the chart shows a *trend* in five successive recordings, this is a good indication that the process is changing and requires investigation with possible corrective action. A *run* is when five successive recordings appear above or below the mean line. This also requires investigation and possible corrective action. A *jump* may indicate that a problem exists and requires correction before the process gets out of control.

Evaluating Process-Monitoring Charts

To be useful, you must be accurate with a control chart and you must analyze it at least daily.

PLOT PATTERNS.—Plots, or points, on a control chart should be thought of as patterns or groups and not as individual points. It is not enough to know where a plot is; you must also know how it got there. In process monitoring, you must be able to recognize patterns that indicate when a process is moving toward an out-of-control condition. After a value is plotted on a chart, the point is connected to the previous point with a straight line. This provides a graphic representation of variations in the process and whether the desired processing conditions are being maintained.

TRENDS.—A drift of plotted points either upward or downward, away from the established mean, with no sudden change in direction is called a *trend pattern.* A trend usually consists of at least five plotted points. An upward or downward trend usually indicates over- or underdevelopment, respectively. The processed images will be either increasing or decreasing in both density and contrast. A trend that is gradual may be an indication of too much or too little replenishment.

JUMPS.—A plot point that jumps or suddenly moves away from previously plotted points may be caused by contamination of the chemistry, improperly mixed chemicals, or mechanical breakdowns, such as replenisher systems or thermostats. A jump pattern is likely to occur after a process has been shut down, especially if the process has not reached the proper operating temperature.

RANDOM PATTERN.—Whereas trends and jumps must be analyzed to determine their probable cause and corrective action taken when necessary, a random pattern within control limits indicates that the process is in control and is not moving toward an out-of-control condition. When an in-control random pattern is maintained, solution strength is probably normal and no correction is necessary; however, when

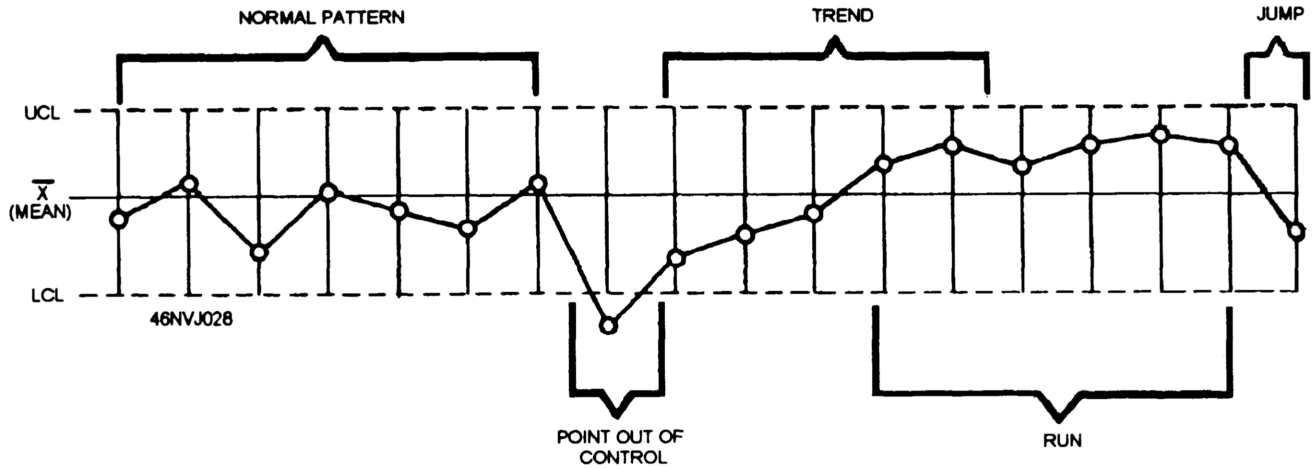


Figure 2-15.—Control chart interpretation.

a random pattern includes a run, the process may need corrective action.

Correct Diagnosis

Sometimes two or more things may go wrong with a process at the same time and it is not clear which of several probable causes is resulting in trend, jump, or run patterns. In this case, each of the probable causes must be investigated until the cause(s) of the undesirable condition is/are found and eliminated. When there is more than one probable cause, you should start with the easiest one to correct, or the one that is most likely to occur.

When there is a sudden jump in the plot, look for factors that occur rapidly, such as changes in chemicals, temperatures machine speed, and so on.

When a plot falls outside of the upper- or lower-control limits, follow the steps given here, in the order of precedence, until you find the cause and correct it:

1. Check the appropriate instrument, such as the sensitometer, densitometer, pH meter, and hydrometer, to be sure it is calibrated and being used correctly.

2. Reread the sensi-strip or control strip densities or chemical sample to eliminate reading error as a cause of out-of-control plots.

3. Recheck the calculations and the plotting of values.

4. Ensure the processing temperature, agitation, and times are correct.

5. Review the chemical mixing and/or replenishment records to determine whether there is a discrepancy.

6. Prove or disprove the value of the questionable out-of-control plot by immediately running another control strip or taking another pH or specific gravity reading, as appropriate. This should eliminate the possibility of one improperly exposed, processed, or handled strip from indicating a problem in an otherwise normal process. When the values of this second reading are within limits, you can assume that the first or out-of-control value was the result of irregular or random conditions, and resume processing. On the other hand, when the second reading also gives an out-of-control value, stop processing production work until the problem has been found and corrected.

Monitoring black-and-white film processing is not difficult. A good-quality assurance program that relies heavily upon process monitoring can enable you to do the following:

- Detect problems before they become serious.
- Test processing solutions and evaluate their usefulness to determine when they need to be replaced.
- Maintain a continuous record of the process.

- Establish correct replenishment rates.
- Eliminate processing variables.

FILM PROCESS RECORDS

One of the first steps in process monitoring is to keep accurate records. The process record should include every factor that may affect the process, including developer temperature, amount of film processed, amount of replenisher added, the person who processed the film or control strip, and the time of processing. By using a processing record form, you can establish and maintain proper replenishment rates and monitor the processing variables that affect processing quality. When control strips indicate that the process is, or is going, out of control, some potential causes can be eliminated by checking the processing record. This often makes it possible for you to determine the source of the problem. Also, when workers maintain processing records, they have an added incentive to follow prescribed processing procedures more carefully.

In any quality assurance program, it is always easier to prevent problems than to correct them after they occur. When you take the following steps, problems in processing can be reduced or eliminated:

- Store chemicals as recommended by the manufacturer.
- Observe effective working and shelf lives of chemicals. Remember, most chemicals change in photographic qualities due to age, both on the shelf before mixing and as working solutions.
- Make sure mixing, storage, and processing equipment is constructed of materials that are not affected by photographic chemicals or solutions.
- Use the purest water possible to prepare solutions and to wash materials.
- Filter water when necessary.
- Label all solution storage and processing tanks.
- Avoid solution contamination.
- Check the volumes of replenisher tanks and processing tanks.
- Check the accuracy of measuring instruments.
- Follow prescribed chemical-mixing procedures.
- Protect solutions with floating lids and/or dust covers.
- Use only proper film and processing techniques.
- Use recommended replenishment rates.
- Use recommended processing times.
- Use recommended processing temperatures.
- Use correct agitation.
- Use proper washing procedures.
- Dry film correctly.

When a control strip or sensi-strip is processed and evaluated at the end of the workday, or shift, you can take immediate steps to correct any problems to avoid delays at the beginning of the next work period.

COLOR PROCESS MONITORING

Much of the material discussed previously about quality assurance is carried over to understand color quality assurance. However, color processing quality assurance is more critical than QA used for conventional black-and-white film, particularly because color balance must be considered.

As with black-and-white QA, color QA procedures begin with a series of controlled exposures, but on color film. These exposures are measured with a color densitometer and then the red, green, and blue densities are recorded on a graph. Control strips for color processing are produced by the manufacturer.

The materials used in color process monitoring are as follows:

- Monitoring manuals

- Control strips and reference strips
- Color densitometer
- Control charts
- Processing records of mechanical and chemical variables

MONITORING MANUALS

Since the details of the monitoring procedure change with each color process, process-monitoring manuals, such as Kodak's Z-series, are necessary supplements to a color process-monitoring system. The monitoring manuals describe the process, the specific control strip to use, the steps to read, the calculation of reference values and control values, the specific plot patterns, and the plot-pattern interpretation.

CONTROL STRIPS

Control strips for color process monitoring are supplied by the manufacturer of the color light-sensitive material or process. The most common control strips used in Navy imaging facilities are Kodak process-control strips. Like black-and-white control strips, color control strips have a series of neutral-density steps. Process monitoring relies primarily on the measurement of densities of the steps.

It is important to measure the minimum density and, usually, two steps representing intermediate tones. Monitoring D-max is also desirable for color reversal film and paper. The relationship among the three color measurements of a step is used to monitor color balance. The difference in the readings from the two steps (HD-LD) provides measurements of red, green, and blue contrast.

Control strips must be stored at 0°F (-18°C) or lower to minimize color shifts. The strips are stabilized and given an expiration date, so they provide a reliable tool to monitor processes. The strips should be removed from the freezer, one at a time, as they are needed.

A number of control strips from each control-strip batch are processed by the manufacturer. One of the processed strips is included with each package of control strips. These processed strips are called *reference strips.* The reference strips provide a means for imaging facilities to determine a process standard in terms of densitometer readings.

By reading these reference strips and applying correction factors (supplied with the control strips) to specified steps, you can determine the initial reference, mean, or aim values.

ESTABLISHING PROCESS-MONITORING PARAMETERS

The first time color process monitoring is used or the first time a process is started up, the steps for establishing a process-monitoring system are as follows:

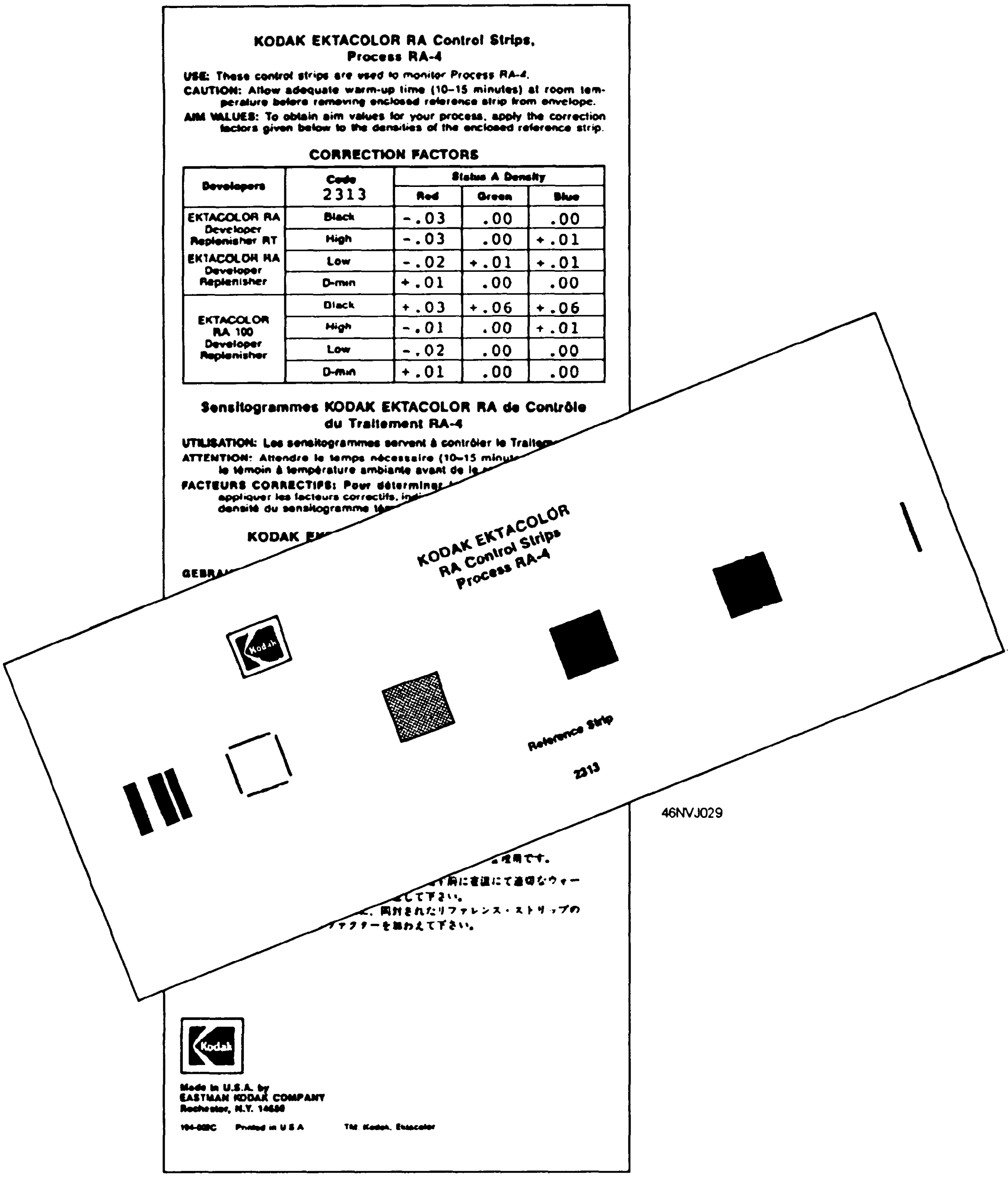
1. Ensure that chemical and mechanical specifications are met. These include mixing procedures, processing temperatures, times, and so forth.

2. Determine initial reference values for the particular code of control strips you are using. This generally consists of reading the reference strip on the densitometer, recording the densities, and adding or subtracting correction factors (supplied with control strips). (See fig. 2-16.) When available, average the reading of several reference strips to minimize the effects of variability.

NOTE: Be sure that the reference strips and control strips you are using have the same code number. A code number is assigned to each emulsion batch, and this code number changes with each emulsion batch manufactured.

3. Process five control strips, one in different production runs. You should always feed the strip in a continuous processor with the low-density end first. The end of the film with the low-density steps is indicated with a dimple on the film. You should also feed the control strips into the processor at the same location of the feed tray. It does not matter whether you feed from the center, the far-right side, or the far-left side. It is important for you to process the control strips consistently to reduce variability.

4. Read the red, green, and blue densities of the specified control-strip density steps on the densitometer and average the values.



KODAK EKTACOLOR RA Control Strips, Process RA-4

USE: These control strips are used to monitor Process RA-4.

CAUTION: Allow adequate warm-up time (10–15 minutes) at room temperature before removing enclosed reference strip from envelope.

AIM VALUES: To obtain aim values for your process, apply the correction factors given below to the densities of the enclosed reference strip.

CORRECTION FACTORS

Developers	Code 2313	Status A Density		
		Red	Green	Blue
EKTACOLOR RA Developer Replenisher RT	Black	-.03	.00	.00
	High	-.03	.00	+.01
EKTACOLOR RA Developer Replenisher	Low	-.02	+.01	+.01
	D-min	+.01	.00	.00
EKTACOLOR RA 100 Developer Replenisher	Black	+.03	+.06	+.06
	High	-.01	.00	+.01
	Low	-.02	.00	.00
	D-min	+.01	.00	.00

Sensitogrammes KODAK EKTACOLOR RA de Contrôle du Traitement RA-4

UTILISATION: Les sensitogrammes servent à contrôler le Traitem…

ATTENTION: Attendre le temps nécessaire (10–15 minut… le témoin à température ambiante avant de le …

FACTEURS CORRECTIFS: Pour détermine… appliquer les facteurs correctifs, ind… densité du sensitogramme té…

Made in U.S.A. by
EASTMAN KODAK COMPANY
Rochester, N.Y. 14650

Figure 2-16.—Correction factors supplied with control strips.

5. Subtract the initial reference values from the averaged, processed control-strip density values. When a control parameter of high density minus low density is specified for the process, determine that also. The results of these subtractions are known as the *aim values*. The example in figure 2-17 summarizes steps 1 through 5 to show you how the aim- or center-line values are derived for an LD step.

In the example below, LD red plots four lines below the center line, LD green plots one line above the center line, and LD blue plots one line below the center line.

6. Adjustment tolerances may be applied to the aim values, as appropriate, to bring the control-strip values closer to the aim values. These adjustment tolerances are specified in each process-monitoring manual. For example, the red low-density (LD) value for your processed control strip is 0.28. The adjusted reference value is 0.32. The process-monitoring manual indicates that the aim-value adjustment tolerance for LD is ±.04. You can adjust the red center-line value by subtracting 0.04 from the adjusted reference values (0.32 – 0.04 = 0.28). The adjusted aim value of 0.28 is your new center line or aim value on your control chart.

NOTE: The adjustment tolerances change for each step and each type of process. You must consult the appropriate process-monitoring manual to obtain these tolerances.

7. Tolerance limits are defined and prescribed in each process-monitoring manual. When the average control values obtained in the preceding step fall within the tolerance limits, production work may be processed and the initial reference values may be used to determine future control values for that particular code of control strips.

8. When average control values fall outside tolerance limits, it is likely that there is a mistake in the following: reading the control strips, performing the calculations, setting up the densitometer, or starting up the process. If errors are not detected, there may be something wrong with the control strip. Improper storage or handling may be the problem. If possible, start over and use a new batch of control strips.

	Red	Green	Blue
Initial reference strip readings of LD (averaged)	0.31	0.52	0.70
Correction factors of LD	+0.01	-0.01	0.00
Adjusted reference values	0.32	0.51	0.70
LD readings of five processed control strips (averaged)	0.28	0.21	0.69
Adjusted reference values minus processed control-strip values	+0.04	+0.01	-0.01

Figure 2-17.—Deriving LD aim values for a process-monitoring chart.

9. When the source of the out-of-control condition is found and corrected, repeat procedures in steps 1 through 6.

LIMITS AND TOLERANCES

Once the mean or standard has been established, *action* and *control limits* are set according to the appropriate monitoring manual. The action limits act as "early warning" limits. Production work can still be processed when the action limit is exceeded, but this indicates that a condition exists that needs to be corrected or the process may drift out of control. Once the process drifts out of control, you should stop production until the problem is corrected. If a control strip shows that the control limits have been exceeded, confirm this with a second strip; then refer to the appropriate monitoring manual and stop production until the trouble is corrected.

As you continue to plot control values, you will see a random variation around the process mean over which you have little control. As long as the control limits are not exceeded, acceptable quality can be expected.

COLOR PROCESS CONTROL CHARTS

A good control program uses control charts and subjective print quality analysis in decision making. A control chart provides a tool to avoid situations where a serious processing error is compensated for in printing to keep print quality acceptable. An imaging facility that is compensating for errors near or beyond the control limits is certain to have more quality problems than a facility operating within acceptable standards.

Preparing a control chart, such as the Kodak Color Process Record Form, No. Y-55, is quite easy. Follow this 8-step procedure:

1. Use a separate chart for each processing machine.

2. Record the reference strip code number and the reference values in the appropriate places. Use color pencils to distinguish the red, green, and blue densities when recording the reference values.

3. Draw horizontal lines to represent the mean, action limits, and upper- and lower-control limits.

4. Record the process and machine number.

5. When plotting the control values, record the date and time that the control strip was processed (not read), and note any chemical or mechanical changes made as a result of the plots.

6. Plot control values having a plus sign above the line that represents the reference value, and plot control values with a minus sign below the reference value line.

7. Connect the points to provide a continuous graph.

8. When changing to a new control strip code number, note it on the chart. Record the date and the new reference values and limits.

The control charts shown in figure 2-18 are not intended to represent an actual control film or process. It is used for illustration purposes only to show patterns that can occur on actual control charts.

Processing Control Strips

Once control charts are established, control strips must be processed on a regular basis. Each color product has a particular control strip with a particular format. In a sink-line process, a control strip should be processed with each run of production film because of human variables. In continuous (machine) processors, control strips should be processed as follows:

- Before processing production work at the beginning of the workday, or shift, or after a long shutdown, such as a weekend.
- Along with production work, at various times throughout the day.
- At the end of each workday, or shift.
- After any chemical or mechanical change. Be sure to indicate this change on the control chart.
- Whenever fresh chemicals are used in the process. Make a note of this on the control chart.

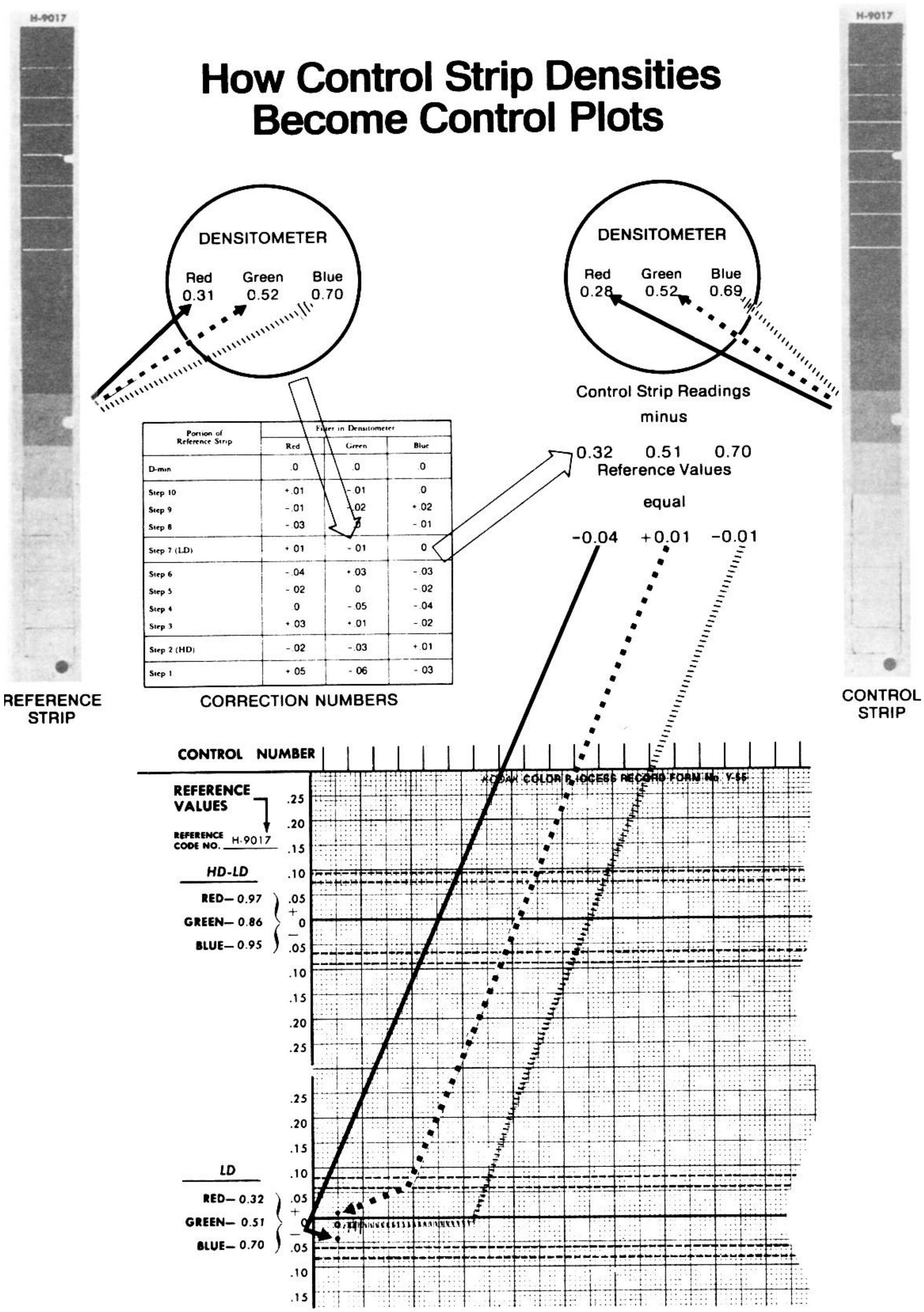


Figure 2-18.—Record Form Y-55.

- Whenever a problem is suspected.

As soon as a control strip comes out of the dryer, identify it with the time and date of processing (not the time it was actually read). A code number identifying a machine or operator is also helpful when your facility has more than one of the same type of processor.

Always inspect a control strip for physical or chemical defects before reading the appropriate densities. Use the middle area of the density steps for taking the density readings. Make each measurement twice. You should use a slightly different area of the step each time, and average the readings.

The emphasis in process monitoring is on densitometry. Keep in mind, however, that changes in the process are made by chemical and mechanical variations, intentional or not. Problems are much easier to track when records are kept of all intentional changes in the following:

- Machine speed
- Solution temperatures
- Replenishment rates
- Agitation
- Filters
- Squeegee adjustments
- Parts (racks, gears, pumps, and lines)
- Operators
- Processing solutions
- Types of film

Figure 2-19.—A Navy Photographer's Mate inspects prints for physical defects that are exiting a processor.
Photo by PH2 Sharon Nelms-Thorsvik

- Control strips

Action to Take When Control Limits Are Exceeded

When you are interpreting control value plots, your first consideration should be to determine whether a plot has exceeded the action limits or control limits. As long as the plots fluctuate within action limits, the process is running in control and generally should be left alone. If a red, green, or blue measurement exceeds the action or control limits, verify the readings, check the process, and immediately process another control strip. When the results confirm those of the first strip, proceed as follows.

An out-of-control situation is serious; therefore, it is important that the information indicating such a condition is correct. When the out-of-control condition is verified by a second control strip, it must be considered real. Two consecutive control strips seldom provide similar false information about a process.

Processing trends and tendencies are not as well defined as control values, but they are equally important. These conditions in the process indicate unnecessary bias or drift away from the mean. For example, when successive plots of control values show that an increasing number of densities are moving away from the mean in a particular direction, you must take corrective action to stop or reverse the trend before plots have moved beyond the control limit. Also, processing conditions that cause control values to plot consistently within but near a control limit are acceptable.

Each of Kodak's Z-series manuals has a section devoted to possible causes of processing problems and visual references of how they appear on a control chart. Diagnostic charts are also provided to give possible causes that can affect the process and what action to take in each instance. Each specific monitoring manual includes verbal descriptions of problems and lists possible solutions.

PHYSICAL QUALITY

The quality assurance and monitoring methods in this chapter discussed sensitometric aspects because they are quite complex. Physical quality, however, is equally important. It is good practice to monitor physical quality along with image quality by a methodical examination of control strips and finished work. The appearance of scratches, digs, spots, or streaks indicates a mechanical malfunction somewhere in the processing cycle (fig. 2-19). In many cases, the causes of these defects are self-evident, and often a bypass test can isolate the malfunction.

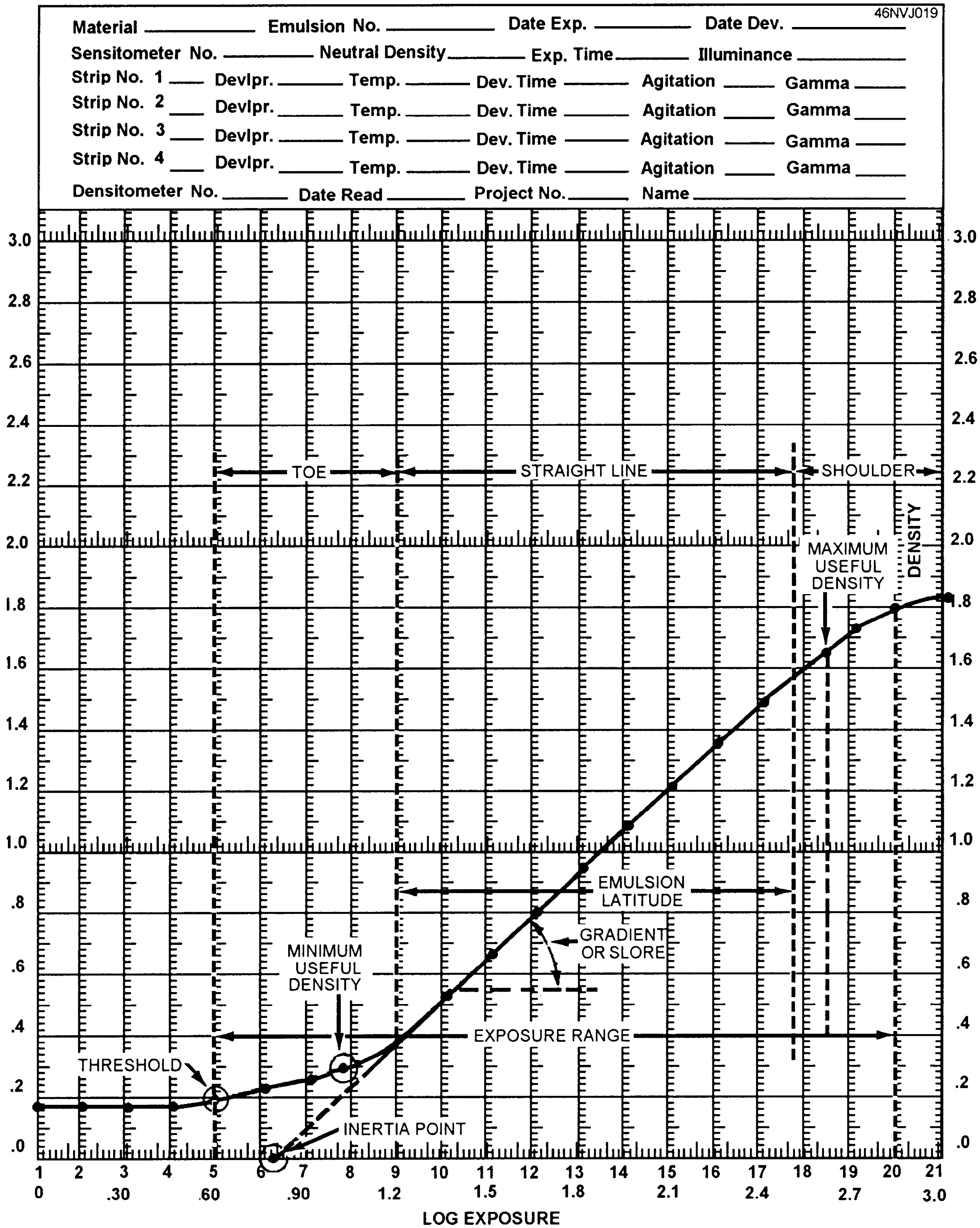


Figure 2-6.—Information derived from a characteristic curve.